2.0 SCOPING AND ISSUES

In accordance with NEPA and SEPA requirements, an early and open public forum process was initiated to determine the scope of issues to be addressed, and for identifying significant issues related to the proposed action. This section discloses the comments, issues, and concerns presented by the project stakeholders during the scoping process and development of the Final Environmental Impact Statement (FEIS).

In a continual effort to include the public, State and Federal agencies, and all interested stakeholders in the process, a Project Delivery Team (PDT) was assembled. Functions of the team were to: 1) provide input for the development of the EIS, 2) keep the public informed of project development, 3) bring forth unknown project related concerns, and 4) to identify natural resources in the Permit Area. The PDT is comprised of a broad based team of individuals who represent the following interests: local, State and Federal government officials; local fishermen, boaters and property owners; non-governmental organizations local university professors and students; as well as the project design team.

Meeting minutes from the June 8, 2005 (Scoping Meeting) and PDT meetings held on July 7, August 23, November 9, and December 14, 2005; February 8, April 12, July 18, and October 3, 2006; April 25, 2007; and July 29 and October 1, 2008 are provided in Appendix A – Subpart 1 (Scoping Meeting and PDT Meeting Minutes). A list of PDT participants is provided in Table 2.

Table 2
Project Delivery Team Members

NAME	REPRESENTING
Harris, Keith	USACE – Wilmington District – Former Regulatory Chief
Walker, Tom	USACE – Wilmington District – Regulatory Chief
Sugg, Mickey	USACE – Wilmington District – Project Manager
McCorcle, Justin	USACE – Wilmington District – Legal counsel
Piatkowski, Doug	USACE – Wilmington District
Shaver, Brad	USACE – Wilmington District
Hall, Howard	US Fish and Wildlife Service
Barbee, Tom	US Marine Corps – Camp Lejeune
Sechler, Ron	NMFS – Habitat Conservation Division
Huggett, Doug	NC Div. of Coastal Management
Giles, Jon	NC Div. of Coastal Management
Everhart, Steve	NC Div. of Coastal Management (also as NC Wildlife Resources Commission representative)
Ellwood, Molly	NC Wildlife Resources Commission
Allen, David	NC Wildlife Resources Commission
Cameron, Susan	Former representative for NC Wildlife Resources Commission
Deaton, Anne	NC Division of Marine Fisheries
Rohde, Fritz	National Marine Fisheries Service (former representative for NC Division of Marine Fisheries)
Carpenter, Rich	NC Division of Marine Fisheries
Lutheran, Noelle	Former representative for NC Division of Water Quality
Steenhuis, Joanne	NC Division of Water Quality
Giles, Mike	NC Coastal Federation
Wilgis, Ted	NC Coastal Federation
Duval, Michelle	Environmental Defense Fund
Walter, Steve	Topsail Island Shore Protection Comm.
Bowman, Becky	North Topsail Beach – Vice Chairman, Beach Nourishment Committee
Carbone, Loraine	North Topsail Beach – Former Town Clerk
Clough, Kathleen	North Topsail Beach – Town Clerk
Cox, Sheila	North Topsail Beach – Former Capital Projects Manager
Godwin, Buddy	North Topsail Beach – Beach Nourishment Committee
Handy, Fred	North Topsail Beach – Former Alderman
Hardison, Larry	North Topsail Beach – Mayor Pro
Knowles, Rodney	North Topsail Beach – Former Mayor
Martin, Don	North Topsail Beach - Mayor

NAME	REPRESENTING
Macartney, Dick	North Topsail Beach – Chairman, Beach Nourishment Committee
McLaughlin, Sue	North Topsail Beach
Peters, Richard	North Topsail Beach - Alderman
Smith, Brad	North Topsail Beach – Former Town Manager
Burleson, Lara	North Topsail Beach – Town Manager
Andrews, Jeff	Coastal Planning & Engineering, Inc.
Campbell, Tom	Coastal Planning & Engineering, Inc.
Hague, Erin	Former marine scientist for Coastal Planning & Engineering, Inc.
Kruempel, Craig	Former environmental project manager for Coastal Planning & Engineering, Inc.
York, Dawn	Former Coastal Biologist for Coastal Planning & Engineering of NC, Inc.
Jarrett, Tom	Coastal Planning & Engineering of NC, Inc.
Willson, Ken	Coastal Planning & Engineering of NC, Inc.

The following commenting opportunities were made available to State and Federal agencies and interested stakeholders to provide comments, questions and concerns regarding the project and development of the EIS:

- The USACE – The Public Notice of Intent was published in the Department of the Army Federal Register on May 19, 2005, and the Wilmington District issued a Public Notice on May 24, 2005 for the proposed project involving work in New River Inlet and along 7.25 miles of beachfront shoreline in North Topsail Beach (Appendix A – Subpart 3).

- June 8, 2005 Public Scoping Meeting (Appendix A – Subpart 1).

- PDT Meetings held on July 7; August 23; November 9 and December 14, 2005; February 8; April 12; July 18 and October 3, 2006; April 25, 2007; July 29 and October 1, 2008 (Appendix A – Subpart 1).

- The USACE – The Wilmington District issued an amended Public Notice on October 4, 2006, and an amended Public Notice of Intent was published in the Department of the Army Federal Register on October 10, 2006 for a project modification involving an additional 3.85 miles of beachfront shoreline in North Topsail Beach (Appendix A – Subpart 3).

- The USACE – The Wilmington District issued a Public Notice on December 13, 2007, and a notice was published in the Department of the Army Federal Register on December 14, 2007 announcing the release of the Draft EIS and the date of the Public Hearing, as well as requesting comments.

- The US Environmental Protection Agency (EPA) - The Notice of Availability for the Draft EIS was published in the EPA Federal Register on December 28, 2007 (Appendix A – Subpart 3).

A Public Hearing was held on January 9, 2008 at the North Topsail Beach Town Hall.

2.1 ISSUES EVALUATED IN DETAIL

During the public meetings, several issues were identified, both written and verbally, in association with the proposed project. Issues raised during the public meetings include: nearshore and offshore hardbottom communities; recreation; shorebirds, colonial waterbirds, and navigation. Additional written correspondence has been provided in Appendix A - Subpart 2 (Pertinent Correspondence).

Summaries of the meetings held to date are listed below:

- The June 8, 2005 public scoping meeting included a presentation on the scope of the project, natural resources near North Topsail Beach and New River Inlet, concerns and issues involved with the project considerations. Attendees of this meeting were separated into several groups to provide statements, comments and questions related to the North Topsail Beach Shoreline Protection Project. The groups were divided up evenly with a facilitator to ensure that the discussions and issues presented remained well organized. The issues and concerns expressed from each group were then presented to all attendees of the Public Scoping Meeting and documented for inclusion in the EIS (Appendix A – Subpart 1).

- The July 7, 2005 PDT meeting included the following discussion topics: the purpose and need for a solution to the current erosion problems along North Topsail Beach; proposed project design; sand source area; and preliminary results of marine resource investigations.

- The August 23, 2005 PDT meeting included the following discussions: Draft Engineering, Geology and Geotechnical Investigations Report; offshore sand resource area investigations; project alternatives; infrastructure and tax base; beach fill design; channel design; and birds.

- The November 9, 2005 PDT meeting included a discussion of the proposed Permit Area, pre-project monitoring, and a summary of the October 2005 hardbottom investigations.

- The December 14, 2005 PDT meeting focused on the results of the geotechnical investigations in the vicinity of the offshore sand source.

- The February 8, 2006 PDT meeting included a discussion on the project alternatives, the possible inclusion of the southern 3.85 miles of North Topsail Beach, navigation issues in New River Inlet, property ownership, recreational usage, nearshore hardbottoms and EIS schedule.

- The April 12, 2006 PDT meeting included the following discussions: beach fill design, buffer zone for hardbottom resources, hardbottom monitoring plan and project alternatives.

- The July 18, 2006 PDT meeting included a summary of the "Physical and Biological Community Analysis of the Nearshore Environment of Onslow Bay and New River Inlet" regarding the proposed 400-foot buffer zone, developments of the bird monitoring plan, and Biological Assessment for Section 7 Consultation with the U.S. Fish and Wildlife Service.

- The October 3, 2006 PDT meeting included a discussion on the "Draft Bird Monitoring Plan" and "Hardbottom Monitoring Plan".

- The April 25, 2007 PDT meeting included an update on the project funding status, review of the Preliminary Draft Environmental Impact Statement, and a discussion on potential hardbottom mitigation.

- The July 29, 2008 interagency meeting included a discussion on biological monitoring and a review of Skip Kemp's proposal on infaunal monitoring.

- The October 1, 2008 PDT meeting included an overview of the phased construction approach and permitting timeline.

For a detailed disclosure of the issues and concerns addressed during the development of the project see Appendix A, which also includes minutes of each Project Delivery Team meeting.

3.0 PROJECT ALTERNATIVES

Project alternatives were designed to take into consideration technology and economic feasibility as well as respond to 1) the erosion occurring along the north end of North Topsail Beach and associated with the eastward migration of the New River Inlet ocean bar channel, 2) the long-term erosion of the Town's ocean shoreline, and 3) damages associated with coastal storms. The alternatives are no action, a buy-out of threatened homes, a combination of beach nourishment and a 30-year inlet management strategy, beach nourishment with no inlet management strategy, beach nourishment with a one-time channel event, inlet management only and the construction of a terminal groin at the north end of the Island Adjacent to New River Inlet.

A Project Delivery Team (PDT) for the North Topsail Beach Project (Project) was established to guide the formulation of the non-Federal project and the Environmental Impact Statement (EIS) by 1) identifying environmental issues and concerns, 2) formulating alternatives that would address all or most of the Project's objectives (refer to Section 1.3), and 3) assessing the need for developing and implementing biological monitoring plans. The PDT, which was lead by the U.S. Army Corps of Engineers – Wilmington District Regulatory Office (USACE), included representatives from Federal and State agencies and other interested stakeholders (refer to Section 2, Table 2 for list of PDT attendees).

3.1 RATIONALE

North Topsail Beach has low relief with elevations in the areas located landward of the frontal dune ranging from 5 to 9 ft above North American Vertical Datum (NAVD). The frontal dune is relatively thin and has been reconstructed on several occasions following coastal storms, most recently following Hurricane Ophelia, which impacted the area in September 2005. Even with dune reconstruction, development and infrastructure within the corporate limits of the North Topsail Beach remain vulnerable to impacts associated with coastal storms, including hurricanes and nor'easters. Long-term shoreline erosion and shoreline fluctuation at its north end, associated with uncontrolled changes in the position and alignment of the ocean bar channel of New River Inlet, also increase the Town's vulnerability.

3.2 DESCRIPTION OF ALTERNATIVES

Alternatives were developed and evaluated based on the effectiveness of stemming inlet induced erosion, the level of storm protection, the level of long term erosion mitigation, environmental consequences, feasibility, cost, and current state laws. The PDT, through the scoping process, developed seven (7) alternatives to be evaluated in the EIS. Two (2) of the alternatives, No Action and Buy-Out/Relocation, were included as shoreline management options that would not include any artificial means of protecting the Town's tax base and

infrastructure other than temporary sandbags. The No Action Alternative also provides the basis on which to measure the effectiveness of the other alternatives in satisfying the stated purposes of the project which are to preserve the Town's tax base and infrastructure and maintain its tourist oriented economy.

Four (4) alternatives involve various combinations of beach fill and/or inlet management options that would provide varying degrees of protection. As stated in Section 1.3.1, the goals and the objectives of the project include providing short- and long-term protection to properties along the entire length of North Topsail Beach oceanfront. In assessing the nourishment activity on the beach within these four alternatives, the impact evaluation was limited to the construction of the initial phases, or the complete nourishment of the 11.1 miles of oceanfront beach. This construction period extends to a minimum 12-year time frame. Impact evaluation for beach nourishment activities was restricted to the initial construction of the beach and did not include maintenance events. Assessment beyond the initial construction would be incomplete due to the absence of quantitatively identified additional sand sources that would adequately support longer term beach nourishment projects. However, maintenance events associated with the inlet management were able to be evaluated over a 30-year period due to the implementation of appropriate engineer modeling and quantitative assessment of the environment setting within the inlet.

The seventh alternative, a terminal groin on the south side of New River Inlet, would address the erosion problems immediately south of the Inlet but would not provide any protection for the majority of the Town's shoreline.

The impact of sea level rise on shoreline recession rates along North Topsail Beach was taken into account during the formulation of the sediment budget used in the design of the inlet management plan and is presented in Appendix B – Final Engineering Report in the Section entitled "Existing Sediment Budget". The historic rate of sea level rise applicable to North Topsail Beach in the vicinity of New River Inlet is around 0.0125 ft/yr or 1.25 ft per century. The portion of the existing shoreline recession rates associated with this rate of sea level rise was estimated to be 0.5 foot/year. Compared to the shoreline recession rates being experienced along most of North Topsail Beach, sea level rise appears to be a minor component. Should sea level rise accelerate, only the sea level rise component of shoreline recession would be affected. For example, should sea level rise double over the next century, the sea level rise component would increase to 1.0 ft/year. The existing rate of rise in sea level has not appeared to have an impact on the performance of the Wrightsville Beach and Carolina Beach federal shore protection projects as nourishment rates have remained fairly constant over the last 25 to 30 years.

3.2.1 Alternative 1 – No Action Alternative

The basic premise of the No Action Alternative is that the Town of North Topsail Beach and its property owners would continue to respond to erosion and storm related problems as they have in the past, namely, installation of temporary sandbag revetments to protect threatened buildings and infrastructure, and the eventual relocation or demolition of the threatened structures once the sandbag revetments are removed. Other measures, such as the disposal of navigation maintenance material on portions of the North Topsail Beach shoreline by the USACE and occasional sand pushing by the Town to rebuild damaged dune lines, would also continue.

The instability of the shoreline immediately southwest of New River Inlet poses the most immediate shoreline management concern. During the past year, 17 duplex structures located at the extreme north end of Town, which have a total tax value of over $17 million, have become imminently threatened. Attempts have been made by individual property owners to protect the threatened duplexes with sandbag revetments. However, most of the sandbag revetments have failed to provide any substantial degree of protection. Two (2) of the imminently threatened duplexes were relocated to other parts of North Topsail Beach at the expense of the property owners. Six (6) of the remaining duplexes have been declared uninhabitable due to the loss of water, sewer, and electrical connections and were demolished in February 2009 at a cost to the Town of $2 million.

The economic impact of the No Action Alternative includes an assessment of: (a) costs for installing temporary sand bags to protect threatened structures, (b) cost for relocating and/or demolishing threatened structures, and (c) potential storm damages to existing structures and infrastructure. The continuation of this erosion response alternative over the next 30 years is projected to have an economic loss to individual property owners in the form of storm damage costs and costs for relocating and or demolition of homes. Likewise this continued erosion response alternative would have an economic loss to the Town, County, and State in the form of reduced revenues from ad valorum, room occupancy, and sales taxes.

The response of individual property owners would include relocating or abandoning their threatened homes. The economic impact of relocating threatened structures included costs that would be borne by the property owners. Relocation costs that would be the responsibility of the individual property owner include cost for (a) installation of a temporary sandbag revetment, (b) fees and permits, (c) abandoning and reinstalling new utilities (water, sewer, electric, telephone, HVAC), (d) removing old piles from the existing lot, (e) installation of new piles on the new lot, (f) costs for relocating of moving the structure and placing it on its new foundation piles, and (g) costs for purchasing a new lot.

Based on the Board of Alderman's Fiscal Year 2007-2008 general fund, the Town's annual revenue is approximately $3.5 million (North Topsail Beach Board of Alderman, 2007). According to a 14 August 2007 survey by the Coastal Area Management Act (CAMA) Local Permit Officer (LPO), 31 residential structures located on North Topsail Beach were considered to be imminently threatened (see Table 1 and Section 1.3 for details). Ten (10) additional homes have been condemned and removed on the north end of the island due to extensive storm damage and erosion. According to the North Carolina Division of Coastal Management (NCDCM), 26 permits have been issued for sandbags since 1992 (J. Giles, pers. comm.). Continuation of the past erosion trends would also necessitate the relocation of an 8,000-ft section of New River Inlet Road in approximately 20 years. Relocation of this section of the road could be required sooner should the area be impacted by a moderate to severe coastal storm in the next 10 years. With regard to storm damages, the existing condition of the beach puts a large number of ocean front structures at a high risk for damage.

The greatest negative impact of the No Action alternative on the local economy would be realized from damages caused by a continuation of past shoreline erosion and the impact of coastal storms ($23.2 million/year), a loss of rental property and the associated reduction in rental income ($4.2 million/year), and a reduction in local spending by vacationers and permanent residents displaced as a result of the loss of their primary residence ($5.6 million/year). The average annual economic impact of these losses over the 30-year evaluation period totals $33.3 million/year for the Central and North Sections. Refer to Table 3 for a cost breakdown of these impacts associated with the No Action Alternative.

The loss of structures over the 30-year analysis period would result in a $366,100/year reduction in ad valorem tax revenues for the Town and County. Room accommodation tax revenues would also be reduced by an average of $254,600/year while sales tax revenues would be reduced by $395,200/year. The cumulative effect of this loss of tax revenue would be $1,015,900/year (Table 3). For specific details on the No Action Alternative see Engineering Analysis –Ocean Shoreline Plan Formulation – Northern 7.25 Miles (Appendix B – Final Engineering Report).

Table 3. Average annual economic impacts of No Action Alternative

Economic Impact	No Action Alternative		
	Central Section	North Section	Total
Damages & Losses			
Erosion & Storm Damages	$5,738,200	$17,688,400	$23,426,600
Rental Income Loss	$529,500	$3,709,800	$4,239,300
Reduction in Household Spending	$207,000	$5,437,600	$5,644,600
Total Damages & Losses	$6,474,700	$26,835,800	$33,310,500
Reduction in Tax Revenues			
Town Ad Valorem	$31,700	$115,500	$147,200
County Ad Valorem	$46,900	$172,000	$218,900
Sales Tax (Local & State)	$14,600	$380,600	$395,200
Accommodation Tax	$31,800	$222,800	$254,600
Total All Tax Revenues	$125,000	$890,900	$1,015,900

3.2.2 Alternative 2 – Buy-Out/Relocation Alternative

The Buy-Out/Relocation Alternative is similar to the No Action Alternative, except temporary sand bag revetments would not be used to assist in protecting threatened structures. Accordingly, once a structure becomes threatened by long-term erosion, the structure would be moved to a new lot, moved back on its existing lot, or demolished. Under the Buy-Out/Relocation Alternative relocation and/or demolition of threatened structures would occur two to five years earlier than under the No Action Alternative based on the size of the structure.

As was the case for the No Action Alternative, the section of New River Inlet Road located between USACE baseline stations 1010+00 and 1080+00 would be protected with sand bag revetments until year 20 at which time the road would be relocated. Failure to maintain this section of New River Inlet Road would result in the cutoff of land access to the northern portions of the Town which would essentially result in the complete abandonment of buildings and infrastructure north of USACE baseline station 1070+00 in year 10. By year 15, all buildings and infrastructure from USACE baseline stations 1010+00 to 1060+00 would be inaccessible. For a detailed description of baseline stations, see Engineering Analysis – Horizontal and Vertical Controls (Appendix B – Final Engineering Report).

Erosion and storm related damages are less for the Buy-Out Alternative than for the No-action alternative primarily due to the assumed earlier demolition of the Topsail Reefs Condominiums and the Villa Capriani during the 30-year analysis period. These reduced structural impacts for the Buy-Out Alternative would be

offset by the higher losses associated with reduced rental income and household spending. Also, the reduction in all tax revenues, including Town and County ad valorem taxes, room accommodation taxes, and sales taxes would be about 50% greater for the Buy-Out Alternative compared to the No Action Alternative. Refer to Table 4 for a cost breakdown of the average annual economic impacts associated with the Buy-Out Alternative.

Table 4. Average annual economic impacts of Buy-Out Alternative

Economic Impact	Buy-Out Alternative		
	Central Section	North Section	Total
Damages & Losses			
Erosion & Storm Damages	$5,166,900	$13,501,100	$18,668,000
Rental Income Loss	$670,500	$6,144,100	$6,814,600
Reduction in Household Spending	$340,000	$8,961,500	$9,301,500
Total Damages & Losses	$6,177,400	$28,606,700	$34,784,100
Reduction in Tax Revenues			
Town Ad Valorem	$40,400	$150,200	$190,600
County Ad Valorem	$60,100	$223,900	$284,000
Sales Tax (Local & State)	$24,000	$627,300	$651,300
Accommodation Tax	$40,200	$368,500	$408,700
Total All Tax Revenues	$164,700	$1,369,900	$1,534,600

3.2.3 Alternative 3 – Applicant's Preferred Alternative

The Applicant's Preferred Alternative includes: 1) an inlet management plan for New River Inlet, 2) a 14-ft NAVD88 dune plan along 7.25 miles of the North and Central sections designed as a Storm Protection project, 3) an interim beach fill project for the southern 3.85 oceanfront shoreline designed as an erosion mitigation project, and 4) a phased construction approach. Implementation of Alternative 3 would be accomplished in five (5) phases which are described below. Alternative 3 is proposed to stem inlet induced erosion at the extreme north end of North Topsail Beach and provide protection against damages due to long-term erosion and storms for Town infrastructure and houses along the northern 7.25 miles of North Topsail Beach (14-ft NAVD88 Dune Plan). Likewise, this option will reduce shoreline erosion along the southern 3.85 miles of North Topsail Beach's oceanfront shoreline in the interim until the Federal Storm Protection Project is constructed (Interim Beach Fill Project).

Geomorphic and Hydrodynamic Analysis

The results of a geomorphic analysis conducted by Dr. William Cleary of the University of North Carolina at Wilmington (Appendix B – Final Engineering

Report) suggest that the change in the behavior of the shoreline between 1984 and 2003 on the northeast end of North Topsail Beach and the southwest end of Onslow Beach correspond to the time when the main channel through the ebb tide delta of New River Inlet began to shift from a southwesterly alignment to a southeasterly alignment. The realignment of the ebb channel was accomplished by a shift in the apex of the ebb tide delta to the northeast or toward Onslow Beach. These changes in the configuration of the ebb tide delta modified sediment transport patterns on North Topsail Beach and exposed the northernmost end of the beach to direct wave attach. Prior to the shift in channel alignment and apex position, the northern end of North Topsail Beach benefited from the protection provided by the ebb tide delta with the section of the shoreline located between baseline stations 1115+00 and 1150+00 advancing an average of 210 ft between 1962 and 1984. Farther to the southwest, the shoreline between baseline stations 1080+00 and 1115+00 advanced an average of 52 ft during this period. Once the inlet channel and apex of the ebb tide delta began to shift toward Onslow Beach, the entire shoreline on the north end of North Topsail Beach between baseline stations 1080+00 and 1150+00 responded by receding at an average rate of 5.3 ft/year between 1984 and 2003.

The results of the geomorphic analysis strongly suggest that an ocean bar channel oriented perpendicular to the adjacent shorelines (i.e. along an azimuth of approximately 150°) would have the effect of shifting the ebb tide delta closer to the north end of North Topsail Beach would provide positive shoreline benefits to the adjacent oceanfront shorelines (Figure 5). Alternative 3 includes the implementation of an inlet management plan for New River Inlet in addition to the construction of a beach fill project along 11.1 miles of the Town's oceanfront shoreline (Figures 6, 7, and 8). The inlet management plan includes repositioning the main ocean bar channel to a more southerly alignment as recommended by the geomorphic analysis with periodic maintenance of the preferred position and alignment (Figure 6). It is important to note that the gorge of the inlet or location of the deepest part of the channel between North Topsail Beach and Onslow Beach is not being modified but rather the seaward extent of the Inlet channel that extends across the ebb tide delta.

The potential changes in the flows and circulation patterns in New River Inlet and the connecting channels associated with modifications in the main inlet channel were evaluated with a numerical model known as ADCIRC (Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries) developed by the Corps of Engineers (Leuttich, et al., 1992). Three (3) channel alternatives were evaluated in the numerical model to determine impacts on flow volumes (tidal prisms), flow patterns, currents, and circulation within the estuarine channels. The selection of the 500-ft x -18 ft NAVD88 channel with an approximate length of 3,500 ft was ultimately based on which alternative provided the greatest assurance that the resulting flow patterns would lead to the ebb tide delta evolution needed to result in recovery of the north end of North

Topsail Beach. A detailed discussion of the numerical model and channel selection criteria is provided in Appendix B – Final Engineering Report.

Inlet Management Plan

Management of New River Inlet involves the initial construction and periodic maintenance of an approximately 3,500 ft. long 500 ft wide x -18 ft NAVD deep ocean bar channel through the New River Inlet ebb tide delta. The gorge of the inlet or location of the deepest part of the channel between North Topsail Beach and Onslow Beach would not be modified, rather only the seaward extent of the Inlet channel that extends across the ebb tide delta would be changed. The new ocean bar channel would begin in the existing inlet gorge and extend along a 155° azimuth to the -18 ft NAVD contour in the ocean. The periodic maintenance and/or relocation of the ocean bar channel to its new position and alignment is a critical element of Alternative 3 and its ability to provide long-term protection for the extreme north end of North Topsail Beach.

Maintenance of the new channel is required to facilitate the recovery of the north end. The north end of the Town is the most vulnerable area due to erosion and shoreline fluctuations caused by uncontrolled changes in position and alignment of the New River Inlet ocean bar channel. As shown in the past, beach nourishment events on this northern end have been unproductive as the material erodes within a few months. If maintenance does not occur on a regular basis, the channel would probably migrate to its present position, thus reinitiating the erosion condition that has created the present problem.

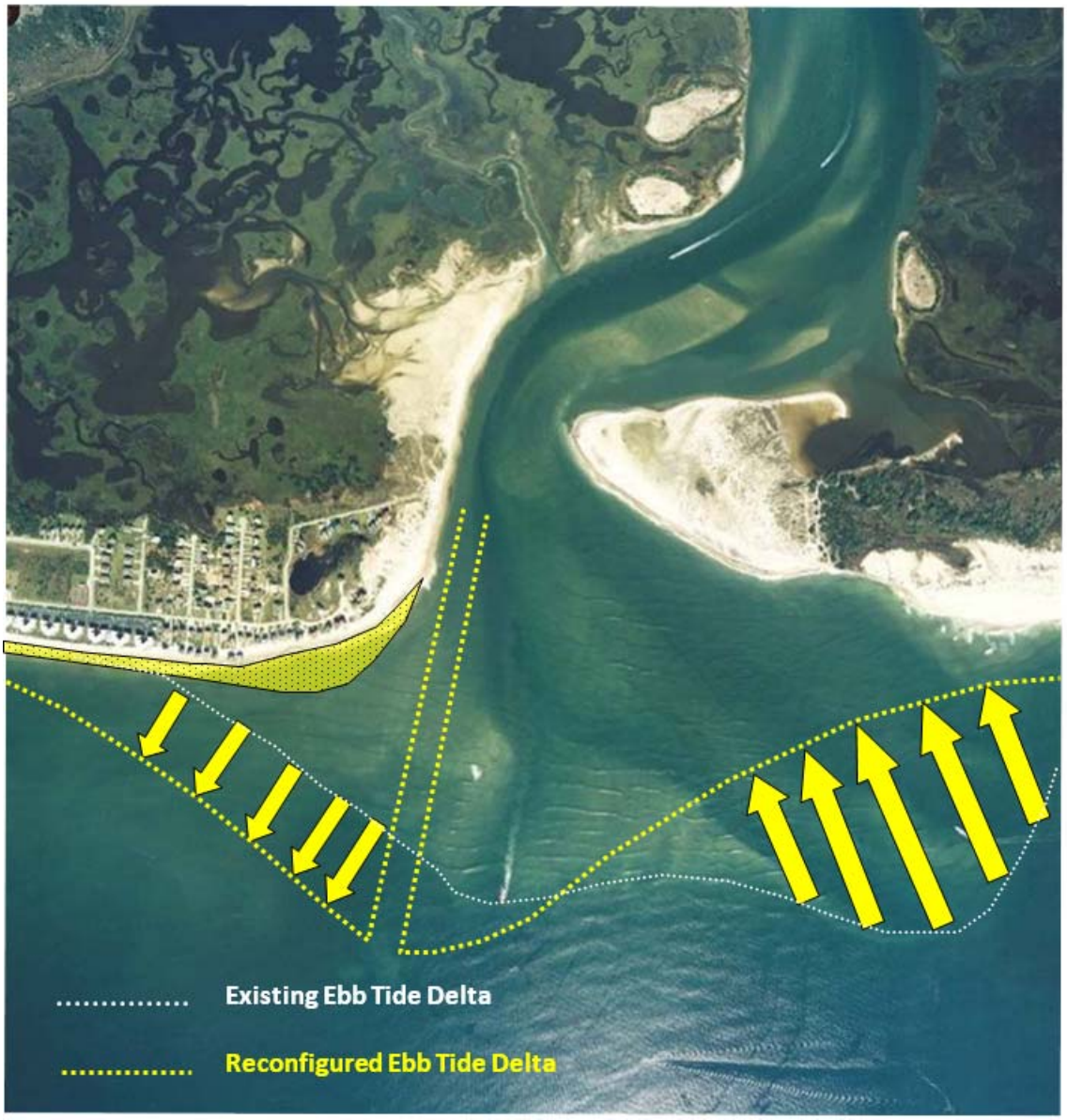

Figure 5. Schematic of Ebb Tide Delta Reconfiguration in Response to Proposed Modification of Ocean Bar Channel (USACE, Oct 03 Photo).

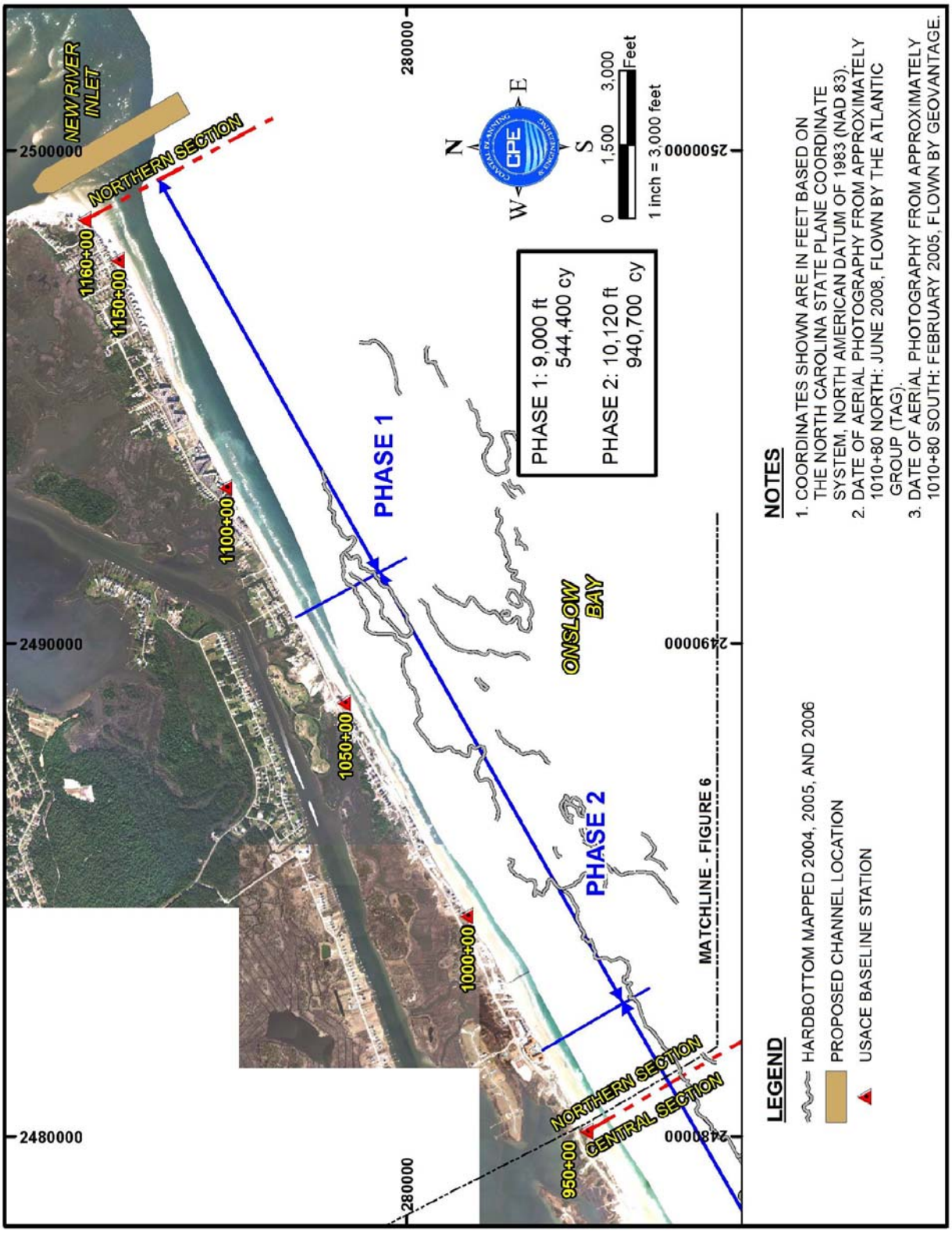

Figure 6. Alternative 3, Applicant's Preferred Alternative – Northern Section

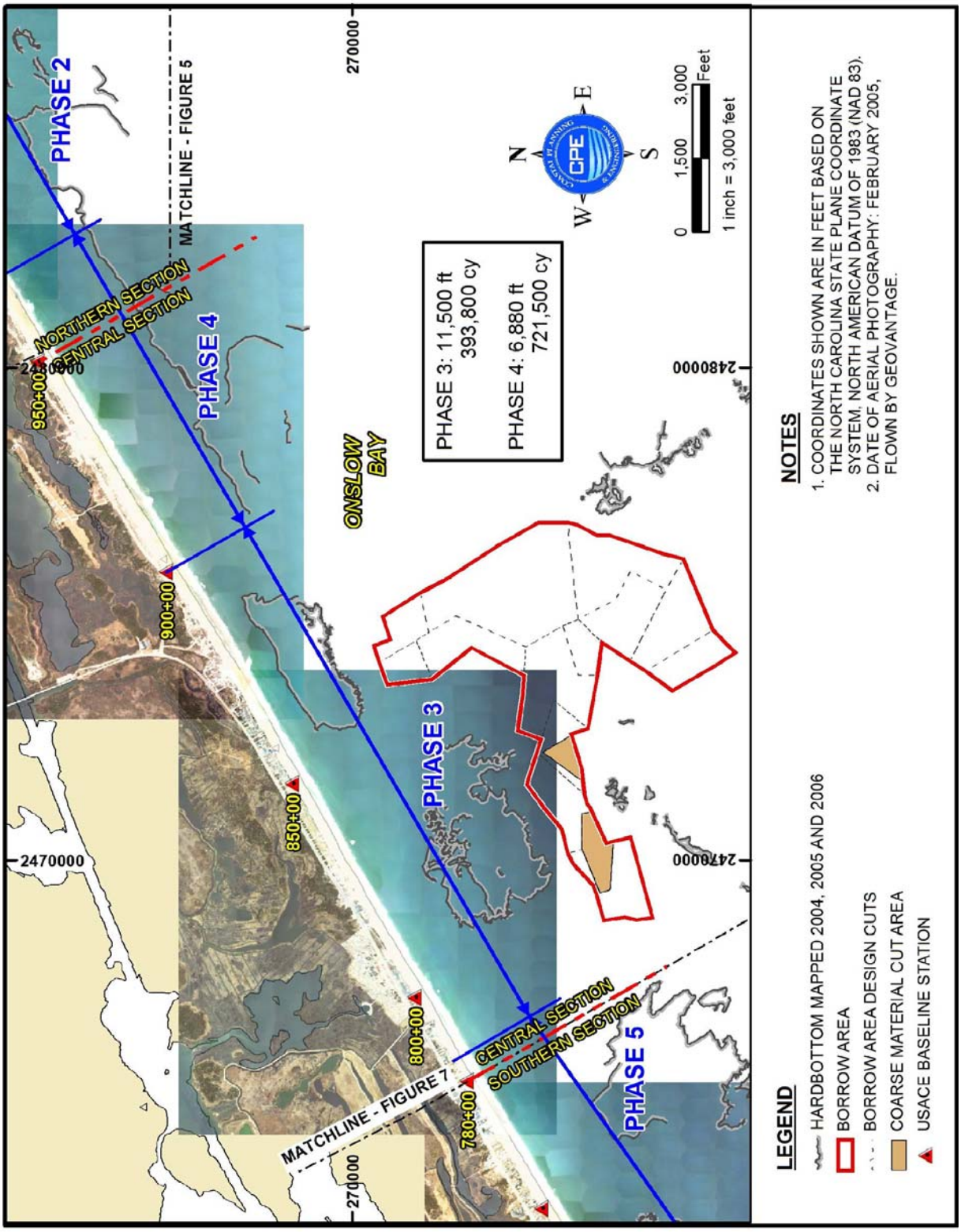

Figure 7. Alternative 3, Applicant's Preferred Alternative – Central Section

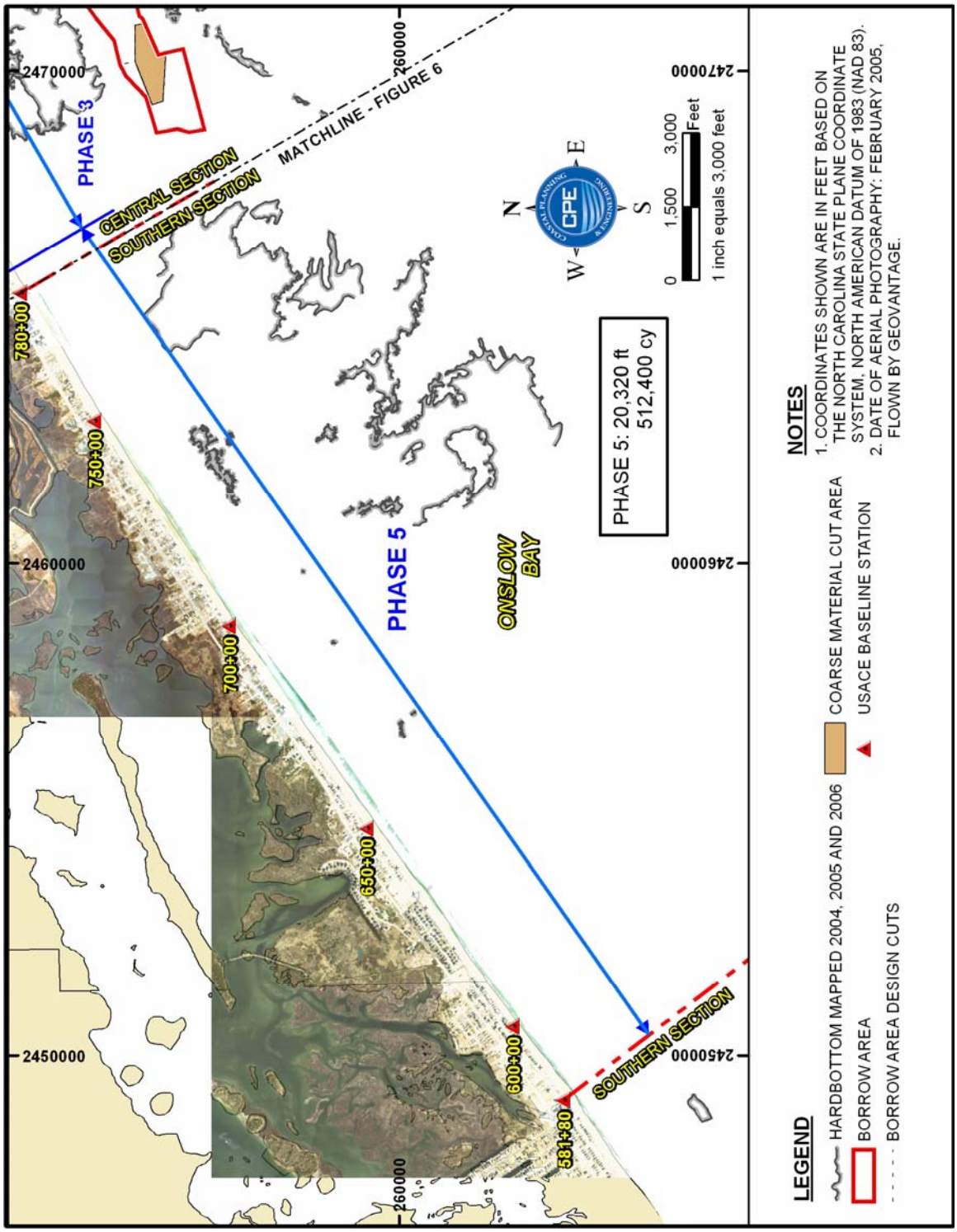

Figure 8. Alternative 3, Applicant's Preferred Alternative – Southern Section

Maintenance of the new channel through New River Inlet is not ebb tide delta mining; rather, it is similar to the channel maintenance activities conducted at both Oregon Inlet and the Cape Fear River Entrance, however, the purpose of the channel maintenance in New River Inlet would be different. Channel maintenance in Oregon Inlet and the Cape Fear River Entrance is required to maintain authorized depths in the navigation channel. In both of these instances the material removed from the channel is placed on the adjacent shorelines. In the case of New River Inlet, channel maintenance is not needed for navigation purposes; it is needed to maintain the preferred channel position and alignment which would facilitate improved shoreline conditions on the extreme north end of North Topsail Beach. As with Oregon Inlet and the Cape Fear River Entrance, the material removed from New River Inlet to maintain the channel would be deposited on the adjacent shoreline.

Two (2) channel thresholds have been established, either one of which could trigger the need to perform maintenance dredging in the new channel. The first channel maintenance threshold would be dictated by shoaling of the new channel totaling 85% of the actual dredge volume of the initial construction. The current estimate for initial construction is 635,800 cy with the channel expected to shoal completely within four (4) years. As the channel shoals, there would be a renewed tendency for it to begin to migrate away from the preferred position and alignment, therefore, maintenance of the channel could be accomplished as a preventative measure when shoaling totals 85% of the initial volume. The second channel maintenance threshold would be the migration of the thalweg of the channel outside the 500-ft wide corridor established during initial construction.

Following the release of the Draft EIS in November 2007, a review of the draft geotechnical report by the NCDCM indicated that in order to comply with the North Carolina technical standards for beach fill projects a minimum of ten (10) vibracores must be taken inside of the borrow site. At the time of the Draft EIS, three (3) vibracores were located within the footprint of the proposed channel due to the readjustment of the channel position to avoid potential cultural resource impacts.

In November 2008, seven (7) additional vibracores were drilled in New River Inlet (Figure 9). Upon collection and analysis of these additional vibracores, it was discovered that discontinuous layers of clay at varying depths were present in portions of the designed channel. Clay sediments were identified above the proposed bottom channel depth of -18 NAVD88 (-17 ft. NGVD29) in vibracores NTVC-08-01, NTVC-08-02, and NTVC-08-06 (Figure 10). Figure 9 depicts cut depths which indicate the deepest depth within each cut that material will be placed on the beach. Material below these depths down to -18 ft NAVD88 (-17.0 ft NGVD29) will be placed in an upland disposal site.

Due to the presence of these clay layers within the designed channel and the incompatibility of the clay on the native beach, an alternative borrow area design was developed. As indicated in the Draft EIS and the geomorphic analysis included in Appendix B – Final Engineering Report, a channel oriented perpendicular to the adjacent shorelines, closer to the north end of North Topsail Beach, would provide positive shoreline benefits for the adjacent oceanfront shorelines. Maintenance of the designed channel to a depth of -18.0 ft. NAVD88 (-17.0 ft. NGVD29) in the preferred position and along the preferred alignment is critical for the recovery of the extreme northern end of the Town's shoreline. Therefore, after discussing the options with the USACE and NCDCM, the Town of North Topsail Beach in coordination with Coastal Planning & Engineering of North Carolina, Inc., the Town's consultant, determined to maintain the inlet channel design as presented in the Draft EIS (CPENC, 2007) and dispose of the underlying clay material within the design template on an upland disposal site located at the junction of the AIWW and New River Inlet (Figure 11).

Figure 9. Map depicting locations of New River Inlet vibracores and channel design. Note, the proposed ocean bar channel ties into the existing position of the Inlet gorge.

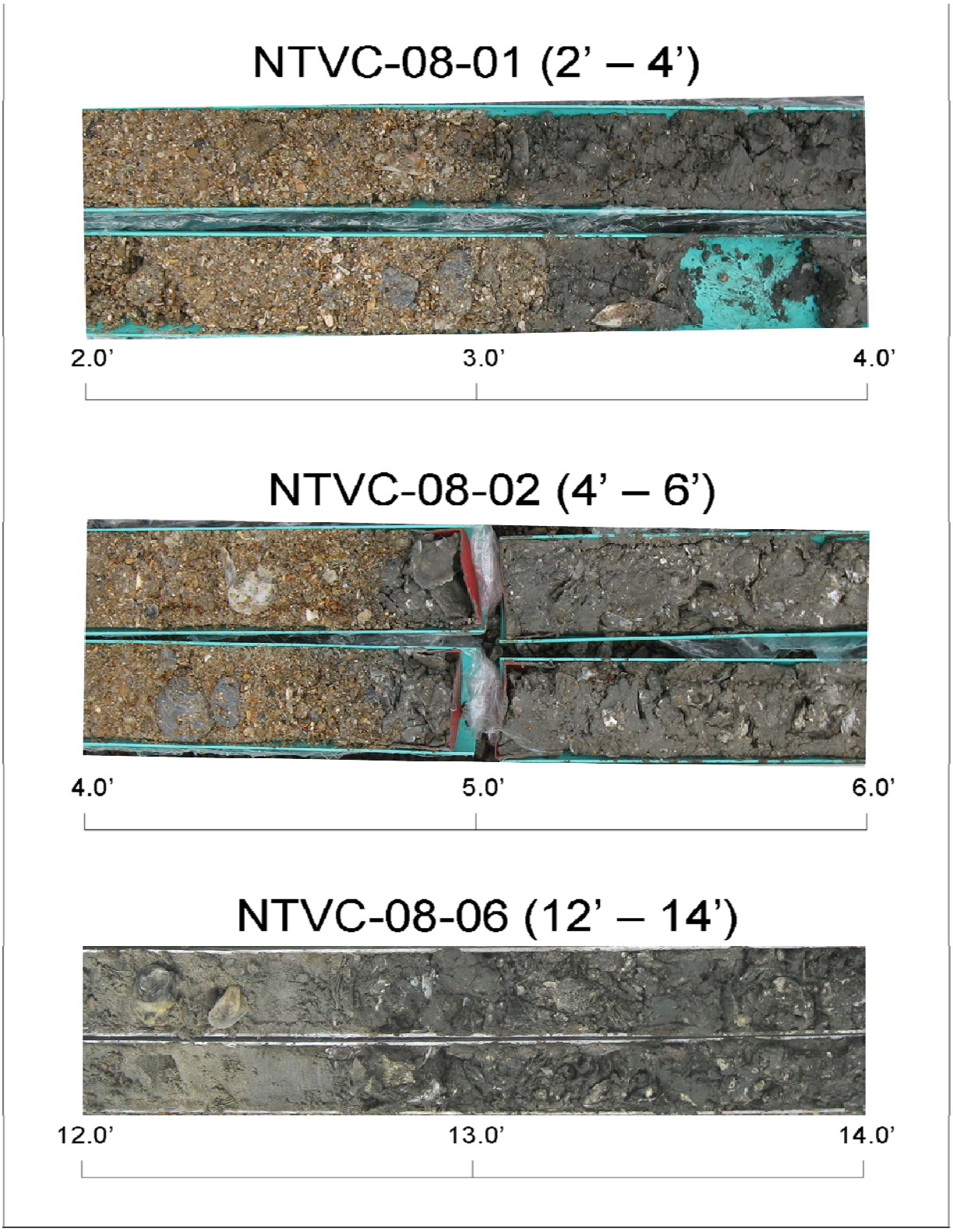

Figure 10. Digital photographs of vibracores NTVC-08-01, 02, and 06, which contained deposits of incompatible clay material. Note depths correspond to the top of core being 0.0 and are not referenced to a vertical datum.

Figure 11. Location of the upland disposal site, located at the junction of the AIWW, Cedar Bush Cut, and New River, in which incompatible material from the New River Inlet channel will be deposited

In order to establish maximum cut depths to avoid and minimize placing incompatible material on the beach, the channel template was split into five (5) different cuts with differing bottom of cut elevations (Figure 9). All material below these cut depths down to a bottom of channel depth of -18.0 ft. NAVD88 (-17.0 ft. NGVD29) will be placed in the above mentioned upland disposal site. In addition, avoidance and minimization procedures have been outlined in Section 6, which describe the procedures to be employed to avoid placement of incompatible clay material on the beach.

The composite characteristics of the inlet material located within the design cuts to be disposed of on North Topsail Beach and located above the clay material include a mean grain size of 0.39 mm, 1.49 phi sorting (poorly sorted), and 1.53% silt. The total volume of the channel design cut using a side slope of 1:5 is 635,800 cy. Of this volume, 544,400 cy of material is beach compatible and 91,400 cy is incompatible material. These volumes are based on the 2005 survey of the channel. Given the dynamic nature of the inlet, these volumes are subject to change.

Oceanfront Shoreline Nourishment Plan

The 544,400 cy of beach compatible material removed to construct the new channel would be used during Phase 1 to construct 9,000 ft of the beach fill south of New River Inlet (baseline stations 1070+00 to 1160+00) (Table 5).

As discussed above, periodic dredging of the inlet channel would be required to maintain the preferred position and alignment of the ocean bar channel. The material removed during the maintenance operations will be disposed of along the North and Central sections of the oceanfront shoreline throughout the 30-year life of the project (Figures 6 and 7). Based on estimated shoaling rates in the new channel, the volume of material to be removed from the channel every four (4) years to maintain the ocean bar channel position and protect the north end of North Topsail Beach is 627,000 cy. Consequently, this amount of material, if deposited along the 7.25 miles of shoreline included in the North and Central Sections (Phases 1 – 4), would provide a sufficient amount of material to maintain the beach design for storm protection and erosion mitigation.

Phase 2 of the project (USACE baseline stations 968+80 to 1070+00) will be constructed using the offshore borrow source (Table 5). Within Phase 2 between USACE baseline stations 1020+00 and 1070+00 coarse material from the offshore borrow source will be used to avoid impacts to nearshore hardbottoms (See Section 6.1 for further discussion on the Point of Intercept concept). Phase 3 of the project (USACE baseline stations 785+00 to 900+00) will be constructed using material from the maintenance of the Inlet as construction is scheduled to occur four years after initial inlet construction (Table 5). At the same time Phase 1 will be re-nourished with the material from the inlet maintenance that exceeds that needed to construct Phase 3. Phases 4 and 5 of the project (USACE baseline stations 900+00 to 968+80 and 581+80 to 785+00, respectively) will be constructed using material from the offshore borrow source (Table 5).

In its efforts to locate an offshore sand source for the North Topsail Beach Shoreline Protection Project, CPE-NC conducted an extensive three-phased sand search of the shoreface off North Topsail Beach. The first phase of the sand search involved compiling and analyzing historical data that exist for the North Topsail Beach shoreface. These data were mostly compiled from two datasets. The first data set was developed by Dr. William J. Cleary and the UNCW Marine Geology Lab and included sidescan coverage of the shoreface from the southwest end of Onslow Beach southwest to Surf City from approximately 2.6 – 4.2 miles offshore, including all of North Topsail Beach and 3.0 miles of Surf City. Data from over 100 ground truthing dive sites where bottom substrate, depth of surface sand, and presence of hardbottom were recorded. The UNCW data set also include approximately 35 vibracores from offshore North Topsail Beach and the north end of Surf City. The second data set was developed by the USACE during its feasibility study for the North Topsail Beach/Surf City Shore Protection Project. These data included approximately

360 line miles of seismic data, which provided reconnaissance level coverage of the shoreface from 0.8 – 5.3 miles offshore along the entire length of North Topsail Beach and Surf City. In addition the USACE collected over 369 vibracores within this same area in an effort to locate sand for the Federal project.

The second phases of the sand search conducted by CPE-NC involved reconnaissance surveys (jet probe and geophysical) to ground truth this extensive historical data. The third phase of the sand search included detailed geophysical and vibracore surveys to accurately map the sand source to be used for the project. The three-phased sand search encompassed approximately 72 square miles (46,080 acres) of the shoreface from New River Inlet southwest including all of North Topsail Beach and the northern 3.0 miles of Surf City, from the surf zone out to approximately 5.3 miles offshore.

The offshore borrow area is located between USACE baseline stations 780+00 and 870+00 (approximately 0.4 and 1.6 miles offshore) (Figures 7 and 8). A combination of geotechnical and biological research investigations confirmed the location of exposed hardbottoms in the nearshore and offshore of North Topsail Beach. The location of diver verified hardbottom and quality of sand was used to define the boundaries of the offshore borrow area. A detailed evaluation of the offshore borrow area is available in Appendix C (Final Geotech Report).

Sand samples collected from sediment layers within the borrow area were analyzed for composite grain size characteristics (mean grain size, sorting coefficient, silt content, and shell content). Analysis of the sediment samples conform to the State's technical standards (NCDCM, 2008). Upon locating a secondary incised channel within the relic depression that comprises the offshore borrow area that contained relatively coarser sand than the rest of the borrow area, and based on the need for coarse material to employ the point of intercept concept (See Section 6.1) to avoid impacts to nearshore hardbottoms, the offshore borrow area was divided into two sections, 1) a 459-acre area with finer grain size (composite mean grain size of 0.21 mm) containing approximately 6.19 million cy of sand, and 2) a 23-acre area with coarser material (composite mean grain size of 0.33 mm) containing approximately 357,000 cy of sand. The total volume available from the offshore Borrow Area is 6.55 million cy, including both fine and coarse fill. The design of the offshore borrow area complies with the February 2008 North Carolina State Sediment Criteria Standards (NCDCM, 2008).

Details of the sediment analyses are provided in Appendix C – Final Geotechnical Report. Approximately 3.11 million cy is needed to nourish 11.1 miles of oceanfront shoreline under the initial project. Considering ocean bar channel maintenance and re-nourishment events that will occur concurrently during the initial 8 years of construction of the project, 4.09 million cy of material is needed. The coarse material dredged from New River Inlet and the offshore

borrow area will be placed in the north and central sections in the vicinity of hardbottom outcroppings located approximately 900 to 1,170 ft. offshore of the February-March 2002 mean high water line (USACE baseline stations 855+00 to 890+00 and 1030+00 to 1075+00). Fill placement of the coarse material will extend 1,000 ft south and 500 ft north beyond the limits of the shoreline that coincides with the hardbottom edge to account for possible longshore drift effects (between USACE baseline stations 830+00 to 900+00 and 1020+00 to 1160+00). This design measure is expected to result in the point-of-intercept (depth of closure) occurring between 450 and 600 ft landward of the nearshore hardbottom edge. Specific detailed information regarding how this design measure will be implemented and monitored during construction of the project is provided in Section 6.

Dune Plan

The 14-ft NAVD88 dune plan encompasses a total shoreline length of 7.25 miles ft. (USACE baseline station 785+00 to 1160+00) and includes a 1,000 ft transition on the north end adjacent to New River Inlet (Figures 7 and 8). The 14-ft dune plan includes an artificial dune constructed to an elevation of +14 ft. NAVD with a crest width of 25 ft. fronted by a variable width beach berm at elevation +6 ft. NAVD. Material for the initial construction of the 14-ft dune plan in the North and Central sections (Phases 1 – 4) will be derived from a combination of the offshore borrow area and realigned inlet channel. The volume needed to construct the 14-ft NAVD feature will be adjusted based on profile surveys taken immediately prior to construction and field directions provided by the construction supervisor. The intent of the beach fill design is to provide a 14-ft NAVD dune along the entire length of the beach in the North and Central sections (Phases 1 – 4).

The interim beach fill plan for the South section includes 20,320 ft. (USACE baseline stations 581+80 to 785+00) of the Town's oceanfront shoreline with a horizontal berm constructed to an elevation of +6 ft. NAVD. Construction of the interim fill along the South section would use material from the offshore borrow area (Figure 8). Also, as discussed in Section 1.4, the USACE's present schedule for construction of a Federal storm damage reduction project for the Surf City/North Topsail Beach federal project is November 2014 (G. McIntosh, pers. comm.), which may render this portion of the project unnecessary.

Recovery Period

As previously stated, and detailed in the Appendix B - Final Engineering Report, the goal of the ocean bar channel modification is to return the north end of North Topsail Beach (USACE baseline stations 1135+00 to 1160+00) to a condition comparable to the 1984 shoreline position. The recovery of this section of shoreline due to the re-positioning of the New River Inlet ocean bar channel under the Alternative 3 – Applicant's Preferred Alternative is predicted to take 15

years. The recovery period includes the assumption that the constructed shoreline could be maintained through a program of periodic nourishment using the coarse grain sediment from the maintenance of the new channel in New River Inlet. Appendix B – Final Engineering Report addresses the difficulty in accurately predicting an exact time of recovery by stating "During the period 1984 to 2003, the shoreline in the vicinity of stations 1140+00, 1150+00, and 1160+00 receded averages of 110, 180, and 220 ft, respectively. The repositioned bar channel should result in comparable shoreline recoveries over some period of time. Predictions of the actual time for the shoreline between stations 1140+00 and 1160+00 to respond to the new channel cannot be made with a high degree of certainty; however, significant accretion should occur within 5 years with full recovery occurring within 15 years following the channel relocation."

The revised plan includes placement of 109,100 cy of additional advanced nourishment between baseline stations 1080+00 and 1160+00 to help offset some of the uncertainty and risk associated with the eventual shoreline recovery following channel relocation. With regard to decreased sand supply to North Topsail Beach due to channel shoaling, the plan calls for bypassing the trapped sediment every 4 years to North Topsail Beach. This would create a condition whereby sand would be necessarily bypassed and preserved within the littoral system versus the present situation where material trapped does not return to North Topsail Beach on a regular or predictable basis.

Maintenance of the new channel is required in order to facilitate the recovery of the north end. If maintenance does not occur on a regular basis, the channel would probably migrate to its present position, thus reinitiating the erosion condition that has created the present problem. Maintenance of the channel is not considered to be mining of the ebb tide delta; rather, it is similar to channel maintenance operations carried out in many of the North Carolina Inlets. The major distinction for the New River Inlet channel is the maintenance material would be put back into the littoral system similar to what is presently being done at Oregon Inlet and the Cape Fear River Entrance.

Phased Construction Approach

As described in Section 3.2.3 under Oceanfront Shoreline Nourishment Plan, the Town of North Topsail Beach is proposing constructing the initial shore protection project (Alternative 3 – Preferred Alternative) in five (5) phases, to correspond with its anticipated funding stream that would be generated from multiple sources. The following describes the timing sequence of the five (5) phased initial construction plan.

The first phase of initial construction (USACE Baseline Stations 1070+00 to 1160+00) would occur between 16 November 2010 and 31 March 2011 (environmental dredging window) and would involve the relocation of the New

River Inlet channel. Phases 2, 3, 4, and 5 of initial construction would then take place every other year during the same November to March dredging window.

The Town's shoreline protection project also includes periodic maintenance of the new channel in New River Inlet approximately every four (4) years, beginning in 2014, with disposal of the maintenance material along the North and Central sections. Alternative 3 takes into account inlet maintenance events that occur during the 8 year period of initial construction. The phased construction approach takes into consideration a with- or without-construction scenario of the Federal project in the South section by 2014.

Phased Construction – Without Federal Project

This option assumes the Federal Storm Protection Project will not be in place prior to the initial construction of Phase 5 between 16 November 2018 and 31 March 2019. As such the southern section of the project (The Interim Project) will be constructed to mitigate the effects of long term erosion until such time that the Federal project can be constructed. Cost, fill lengths and volumes associated with each phase of initial construction are provided in Table 5. Refer to Figures 6 to 8 showing the limits of each construction phase. As mentioned previously, some phases of the initial construction coincide with channel maintenance and or scheduled re-nourishment events for previously constructed sections due to the extended time frame (8 years) for the phased construction. These re-nourishment events are also reflected in Table 5. Cumulative construction costs for the five construction phases are provided in Table 6.

Table 5. Construction schedule and costs for initial construction of phases 1 - 5.

Phase	Constr. Years	Baseline Stations	Fill Length (ft)	Volume (cy)	Re-Nourishment (Phase)*	Re-Nourishment Volume (cy)	Total Cost Estimates ($ Millions)
1	2010-11	1070+00-1160+00	9,000	544,400	NA	NA	$5.754
2	2012-13	968+80-1070+00	10,120	940,700	NA	NA	$10.401
3	2014-15	785+00-900+00	11,500	393,800	Phase 1	233,200	$8.226
4	2016-17	900+00-968+80	6,880	721,500	Phase 2	121,800	$8.945
5	2018-19	581+80-785+00	20,320	512,400	Phases 1-3[1]	627,000	$12.930

*Compatible material will be placed on the section of oceanfront shoreline that is needed for erosion protection. Each phase will not be nourished more than once in a 4 year period.
[1] Material will be placed within Phases 1 through 3 dependent on immediate need of erosion protection.

Table 6. Cumulative initial construction costs for the five construction phases.

Phase	Constr. Years	Re-Nourishment (Phase)	Cumulative Construction Cost Estimates ($ Millions)
1	2010-11	NA	$5.754
2	2012-13	NA	$16.155
3	2014-15	Phase 1	$24.381
4	2016-17	Phase 2	$33.326
5	2018-19	Phases 1-3	$46.256

Phased Construction – With Federal Project

If the Federal Storm Protection project is built prior to 2018 Phase 5 of Alternative 3 would not be constructed. As shown in Table 5 the total cost of Phase 5 is estimated to be $12,930,000. Of this cost, approximately 40% ($5,172,000) is associated with the construction of the interim project along the southern section. The additional 60% of the cost ($7,758,000) is associated with the inlet maintenance and re-nourishment of Phases 1 – 3.

Periodic Nourishment and Average Annual Cost

In addition to the two channel maintenance operations that would likely be required during the initial construction phases, channel maintenance would continue to be required in order to protect the development and infrastructure along the extreme north end of North Topsail Beach. Material removed to maintain the channel would be distributed along the shorelines south of New River Inlet to baseline station 785+00 with the actual disposal locations dictated by observed shoreline and fill behavior. As noted previously, the predicted rate of shoaling in the new channel appears to be sufficient to maintain the beach fill along the entire 7.25 miles of shoreline (Phases 1 – 4). The cost per event (every 4 years) to maintain the New River Inlet ocean bar channel with disposal on North Topsail Beach is estimated to be $8,851,000. An average annual cost for Alternative 3 was computed using an interest rate of 6% and a 30-year amortization period. Based on the above cost estimates the average annuals cost would be $3,669,000.

3.2.4 Alternative 4 – Beach Nourishment without the Relocation of the New River Inlet Bar Channel

This alternative involves construction of the same interim beach fill design along the South section (USACE baseline stations 581+80 to 780+00) and the 14-ft (NAVD) dune plan and beach fill design along the Central and North section (USACE baseline stations 785+00 to 1160+00) as discussed in Section 3.2.3. However, this alternative does not include any modifications to New River Inlet. Three sources of borrow material were evaluated for Alternative 4; offshore borrow area, upland borrow area, and combination of offshore and upland borrow areas. These three borrow sources are discussed below:

4a. **Offshore Borrow Area:** Initial construction and periodic nourishment of the beach fill project would be accomplished entirely from the offshore borrow area discussed in Section 3.2.3 and in Appendix C (Final Geotech Report). The borrow area is located offshore of North Topsail Beach between USACE baseline stations 780+00 and 870+00 (approximately 0.4 and 1.6 miles offshore) (Figures 7 and 8). Sand samples collected from sediment layers within the borrow area were analyzed for composite grain size characteristics (mean grain size, sorting coefficient, silt content, and shell content). Analysis of the sediment samples conform to the State's technical standards (NCDCM, 2008). As discussed in Section 3.2.3, the offshore borrow area was divided into two sections, 1) a 459-acre area with finer grain size (composite mean grain size of 0.21 mm) containing approximately 6.19 million cy of sand, and 2) a 23-acre area with coarser material (composite mean grain size of 0.33 mm) containing approximately 357,000 cy of sand. The total volume available from the offshore borrow area is 6.55 million cy, including both fine and coarse fill. A summary of the composite grain size characteristics for the coarse and fine material in the offshore borrow area material are in the Engineering Analysis - Borrow Area Geotechnical Investigations (Appendix B – Final Engineering Report).

Without the inlet management plan, the total volume of material that would have to be dredged from the offshore borrow area for initial project construction, including the South Section, and periodic nourishment of the Central and North Sections over the 30-year planning period would be in excess of 9 million cy. With only 6.55 million cy available from the identified offshore borrow area; an additional offshore source would be needed to satisfy the project needs.

Given the limited volume of coarse material available in the offshore borrow area, construction of the 14-ft NAVD dune plan and beach fill in the areas where nearshore hardbottoms encroach close to shore would be problematic under Alternative 4. The coarse grain material from the offshore borrow area would be used to construct the 14-ft dune plan

between USACE baseline stations 840+00 and 900+00 as well as between baseline stations 1020+00 and 1050+00. This would deplete all of the coarse material in the offshore borrow area resulting in the use of slightly finer material to construct the remaining sections of the 14-ft dune plan and construct the interim fill in the South Section. The use of the finer grained material would require approximately 15% more volume to achieve the recommended design beach profile in these sections. Since construction of the project using the offshore borrow area will deplete the known source of coarse material, a new source of coarse offshore material would need to be identified in order to avoid possible impacts on the nearshore hardbottom. A new offshore source would have to be identified as well to satisfy the 30-year project requirements. The cost of the additional offshore sand search would be approximately $500,000. Assuming the search is successful, the source of the additional coarse grain material will likely be located farther offshore resulting in higher unit dredging costs and higher mobilization and demobilization costs.

The cost for implementing Alternative 4 using the offshore borrow area was determined using the same phased construction approach as Alternative 3. Construction of Alternative 4 would require six phases rather than five due to the additional production time required for pumping sand from an offshore sand source to the North Section. The total construction costs equal $55.959 million, compared to approximately $46.256 million for Alternative 3; however, this estimate for Alternative 4 does not include periodic nourishment required during initial construction of Phases 1 – 6. The estimated additional cost for nourishing Phase 1 during construction of Phase 3 would be $3,162,000. Periodic nourishment of Phases 1 and 2 during construction of Phase 5 would cost $5,320,000. Taking into account these re-nourishment events the total cost for initial construction for Alternative 4 is $64,441,000. Refer to Tables 7 and 8 for breakdown of costs associated with each phase.

Table 7. Phased construction schedule and costs – Alternative 4.

Phase	Constr. Years	Baseline Stations	Fill Length (ft)	Volume (cy)	Cost Estimates ($ Millions)
1	2010-11	1111+00-1160+00	4,900	720,000	$12.991
2	2012-13	1050+00-1111+00	6,100	731,200	$10.787
3	2014-15	972+00-1050+00	7,800	755,900	$9.619
4	2016-17	916+00-972+00	5,600	750,000	$8.659
5	2018-19	785+00-916+00	13,100	832,100	$6.038
6	2020-21	581+80-785+00	20,320	512,400	$7.865

Table 8. Cumulative construction costs for the six construction phases – Alternative 4.

Phase	Constr. Years	Cumulative Construction Cost Estimates ($ Millions)
1	2010-11	$12.991
2	2012-13	$23.778
3	2014-15	$33.397
4	2016-17	$42.056
5	2018-19	$48.094
6	2020-21	$55.959

4b. **Upland Borrow Area:** An upland borrow area would be used to construct the beach fill project in the Central and North Section with the South Section constructed using the offshore borrow area.

The Town of North Topsail Beach recently completed a post-Hurricane Ophelia dune restoration project using a combination of truck haul material from Riverside Sand Company, an upland borrow pit located near the Town of Wallace, NC and material scraped from the foreshore profile of the existing beach. An estimated 47,300 cy of borrow material was delivered to the beach at a cost of $1.05 million. Once delivered to the site, additional costs were incurred to transport the material to the dune and shape the material to the design cross-section.

In addition to the Riverside Sand Company, two other potential sources of upland borrow material have been identified; Hutcheson Landscaping, Burgaw, NC and Morton Minerals Jackson Pit, Jacksonville, NC. However, only Riverside Sand Company indicated they could satisfy the 9 million cubic yard needs of the project (B. Brinkley, pers. comm.). Therefore, Riverside Sand Company was used to develop cost estimates for the upland borrow area alternative.

The Riverside Sand Company pit is located approximately 65 miles from North Topsail Beach. Assuming a truck would travel at an average speed of 50 mph, a roundtrip from the borrow pit to North Topsail Beach, including load time and dump time would be approximately 2 hours 45 minutes. For a 12-hour day, one 20 cubic yard trailer dump truck with an effective load of 17 cy could make an average of 4.3 trips per day and

deliver 74 cy/day to the beach. During the 16 November to 31 March construction period, one truck could deliver about 9,000 cy to the beach. The quality of material in the sand pit relative to the native beach material is not known at this time. A sediment analysis characterizing the quality of the upland material would be needed to assess the compatibility of the material with the native beach and compliance with the State Sediment Criteria Standards (see Section 5.16.7.1 for details on the State Sediment Criteria Standards). However, the assumption was made that the volume of material needed would be the same as that from the offshore borrow area. The volume needed to construct the 14-ft dune plan in the Central and North Sections totals about 3.8 million cy. Accordingly, the number of truck loads required to construct the project would be around 223,500. If the project was constructed over two construction periods, approximately 210 trailer dump trucks would be needed.

An estimate of the unit cost to deliver material from the Riverside Sand Company to North Topsail Beach and spread and shape the material into the design template is provided in the Engineering Report (Appendix B) with the total unit cost equal to $38.20/cubic yard.

The total cost to construct the North and Central Sections of the project using an upland borrow source and the South Section using the offshore borrow area totals $156 million.

4c. **Combination Upland Borrow Area and Offshore Borrow Area:** Due to the sensitive nature of the nearshore hardbottom areas, the known source of coarse material in the offshore borrow area would be used to construct the project from USACE baseline stations 830+00 to 900+00 and stations 1030+00 to 1070+00 as well as the South Section as stated in Section 3.2.3. The remainder of the project would be constructed using material from the upland borrow source identified above in Section 3.2.4 (4b). The total initial construction cost for Alternative 4 using a combination of truck haul and offshore borrow material would be over $150 million.

Periodic Nourishment and Average Annual Cost

Over the course of the 30 year project period, over 9 million cy of material would be needed to maintain the 14-foot Dune Plan along the northern 7.25 miles of North Topsail Beach. For Alternative 4, all periodic nourishment would have to be obtained from offshore borrow sources as upland borrow sites do not appear to be economical or practical. The initial construction of the project would deplete all known sources of coarse grain material in the offshore borrow area, necessitating additional offshore sand searches to locate a sufficient quantity of coarse grain material to nourish the sections of the project which have hardbottoms located close to shore. The cost of this additional offshore sand search would be approximately $500,000. Assuming the search is successful,

the sources will likely be farther offshore resulting in higher unit dredging costs and higher mobilization and demobilization costs. The cost per event (every 4 years) to re-nourish the northern 7.25 miles ft of North Topsail Beach with material from an unknown offshore borrow source is estimated to be $10,649,000. An average annual cost for Alternative 4 was computed using an interest rate of 6% and a 30-year amortization period. Based on the above cost estimates the average annuals cost would be $4,964,000.

3.2.5 Alternative 5 – Beach Nourishment with One-Time Relocation of New River Inlet Bar Channel and No Channel Maintenance

Alternative 5 includes the 14-ft (NAVD) dune plan in the Central and North Sections as discussed described in Section 3.2.3 and would be constructed using a combination of material from the offshore borrow area and a one-time relocation of the ocean bar channel. The design of this one time construction of the ocean bar channel are the same as that described above in Section 3.2.3. The interim plan in the South Section would be constructed using material derived from the offshore borrow area as described in Section 3.2.3. Periodic nourishment along the North and Central Sections would be accomplished using offshore borrow areas. The initial construction cost for Phases 1 and 2 of Alternative 5 would be the same as the Applicant's Preferred Alternative (Alternative 3) presented in Section 3.2.3. The estimated total cost for Phase 3 would be $5,149,000; however, this would not include the re-nourishment of Phase 1 which was included in the cost given previously for Phase 3 under Alternative 3. The additional cost to re-nourish Phase 1 during construction of Phase 3 is $3,162,000, which would bring the equivalent cost of Phase 3 to the cost given under Alternative 3 to $8,311,000. Construction of Phase 4 would cost $7,883,000. Phase 5 is estimated to cost $7,790,000; however, as was the case for Phase 3, additional re-nourishment would be necessary for previously constructed phases during the initial construction of Phase 5. The total cost of Phase 5 including the re-nourishment of previously constructed sections is estimated to cost $18,390,000.

A review of the channel orientation tendencies indicates that the channel moved from a southwesterly alignment in 1984 (azimuth greater than 150^{o}) to a shore normal alignment (150^{o} azimuth) by 1991. If the new channel reacts in a similar manner, shoreline recovery on the north end of North Topsail Beach would probably be limited to a five-year period; after which time it would begin to erode at rates comparable to the 1984 to 2003 period.

Periodic Nourishment and Average Annual Cost

Periodic nourishment costs for Alternative 5 would be the same as Alternative 4, $10,649,000 (Section 3.2.4). An average annual cost for Alternative 5 was computed using an interest rate of 6% and a 30-year amortization period. Based on the above cost estimates the average annuals cost would be $4,120,000.

3.2.6 Alternative 6 – Inlet Management Plan

Under Alternative 6, the 500 ft wide x -18 ft NAVD channel with an approximate length of 3,500 ft as detailed in Section 3.2.3, would be constructed. Material removed to construct the realigned channel would be evenly distributed along 7.25 miles of ocean shoreline within the Central and North sections of North Topsail Beach. The interim plan for the South Section (Phase 5) would still be constructed using the offshore borrow area as described in Section 3.2.3. Material removed from the channel during maintenance operations would be evenly distributed to maintain the shoreline along the northern 7.25 miles of North Topsail Beach.

As discussed in Section 3.2.3, the volume of material that would be removed to construct the new channel is presently estimated to be 635,800 cy based on the August 2005 survey of New River Inlet. However, as discussed previously, the actual volume of material that would be removed to construct the new channel could vary due to changes in the condition of the inlet as well as the presence of approximately 91,400 cy of incompatible material. As indicated in Section 3.2.3, this incompatible material will be placed in an upland disposal site located at the junction of the AIWW, New River, and Cedar Bush Cut (Figure 11). Assuming the constructed volume for the new channel is approximately 544,400 cy, the equal distribution of channel material along the North and Central sections would result in an average placement rate of 14 cy/lineal ft of shoreline. The construction width of the +6.0 ft NAVD berm would be approximately 30 to 35 ft with the adjusted width equal to 10 to 15 ft.

Material for the periodic nourishment of the beach fill along the North and Central Sections would be derived from the maintenance of the realigned channel in New River Inlet with the material equally distributed along the entire 7.25 miles. The same thresholds described in Section 3.2.3 for channel maintenance would apply under Alternative 6. Periodic nourishment of the southern 3.85 miles of the Town's shoreline would be associated with the implementation of the federal storm damage reduction project and is therefore not included.

The estimated rate of shoaling of the new bar channel appears to be sufficient to satisfy periodic beach fill nourishment requirements along the North and Central Sections. However, if shoaling of the channel does not satisfy nourishment requirements, an upland source of suitable borrow material would need to be identified.

3.2.7 Alternative 7 – Terminal Groin

In 2003, the State of North Carolina modified the Coastal Area Management Act of 1974 (CAMA) to prohibit the use of "hard structures" as coastal erosion response measures. Prior to the amendment, hard structures had been prohibited by rules adopted by the North Carolina Coastal Resources Commission (CRC). During the 2007 North Carolina Legislative Session, the Senate passed a bill that would allow the installation of an experimental terminal groin at an unspecified inlet. A terminal groin is defined as a singular structure constructed immediately adjacent to a tidal inlet which is designed to reduce shoreline erosion caused by a combination of wave and tidal current induced sediment transport. The bill would require the groin to be evaluated in an Environmental Impact Statement and approved by the Coastal Resources Commission prior to installation. The bill moved to the NC House (Senate Bill 599) but no action was taken prior to adjournment of the Session. A similar bill was introduced in the Senate during the 2009 Legislative Session. The bill was also passed by the Senate and is presently being considered by the House. On 26 August 2009 the General Assembly of North Carolina passed House Bill 709 as Session Law 2009-479. This legislation requires the CRC to conduct a study of the feasibility and advisability of the use of terminal groins as erosion control devices. The legislation requires the CRC to present a report to the Environmental Review Commission and the General Assembly by April 1, 2010. The Environmental Review Commission is a joint legislative study committee. At the time of this document (September 2009), no final decision had been reached on the proposed terminal groin legislation.

A group of citizens who own property along the north end of North Topsail Beach proposed using Holmberg Technologies, as an alternative to beach nourishment and channel relocation, as a means to protect the entire North Topsail Beach shoreline. Holmberg Technologies is a proprietary shoreline protection device that consists of a series of low lying concrete filled nylon bags constructed perpendicular to the shoreline. In October 1998, the North Carolina Coastal Hazards Science Panel, a panel of coastal experts established by the CRC to provide technical advice to the CRC on complicated matters, reported to the CRC that the Holmberg Technologies was not an innovative erosion control device in that it had all the characteristics of a groin system. Since the Hazards Panel report preceded the 2003 modification to the CAMA, CRC rules in effect at the time would prohibit the use of the Holmberg Technologies in North Carolina. With the 2003 modification of CAMA referenced above, Holmberg Technologies are prohibited by State Law along with all other types of hard erosion control measures.

Even though existing State law prohibits hard structures, a terminal groin alternative was evaluated as a possible means of protecting development on North Topsail Beach located adjacent to the south shoulder of New River Inlet. The terminal groin option was selected over other types of hard structures,

including the Holmberg Technologies, since terminal groins have been used successfully to control inlet related shoreline erosion in North Carolina at Beaufort Inlet and Oregon Inlet.

A terminal structure on the extreme north end of North Topsail Beach would consist of a revetment along the inlet shoreline and a groin extending into the ocean. The total length of the terminal structure would be approximately 2,500 ft with the landward most 1,000 ft constructed as a sloping rubble revetment and the seaward 1,500 ft constructed either as a free-standing rubble mound or a single row of concrete sheet piles. The terminal groin would ostensibly create an accretion fillet that would widen and stabilize the shoreline from the inlet shoulder south to baseline station 1135+00, or a distance of 2,500 ft. Depending on the structural design of the terminal groin, construction costs could range from $7.5 to $10.0 million.

The terminal groin would be designed to facilitate the one time recovery of the shoreline without continually entrapping littoral sediment. Accordingly, the crest elevation of the groin would be +6 ft NAVD or equal to the elevation of the natural berm in the area. The length of the groin would be limited to that necessary to stabilize the 2,500 ft of shoreline to its south. With these design features, once the accretion fillet is completely formed, littoral material would be free to pass over the crest of the groin and around its seaward end.

The volume of material that would be permanently trapped by the groin would range between 150,000 cy and 200,000 cy, depending on its final design characteristics. The rate of littoral sediment transport moving toward New River Inlet from North Topsail Beach is estimated to be 270,000 cy/year (see Appendix B - Figure 53). Therefore, fillet formation should take less than one year after which no additional sediment accumulation would occur. Note that the littoral material trapped by the groin would be material destined to be deposited in New River Inlet, a large percentage of which remains trapped in the inlet under existing conditions.

While the terminal groin would not provide any protection for the majority of North Topsail Beach, it would allow a beach fill to be extended all the way to New River Inlet. In this regard, the terminal groin would control losses from the north end of the fill due to tidal currents flowing into the inlet, as well as accelerated sediment transports rates associated with wave transformations over the inlet’s ebb tide delta.